

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Previously presented) A thermal microelectrical mechanical actuator, comprising:
a planar substrate with first and second anchors secured thereto;
an in-plane shuttle floating on the substrate for motion parallel to the planar substrate;
an elongate floating cold beam that is transverse to the length of the in-plane shuttle,
the floating cold beam being coupled at one end to the in-plane shuttle and at another end to
the substrate;
plural elongated thermal half-beams that each have a base end secured to the first
anchor and a distal end secured to the in-plane shuttle;
plural elongated thermal half-beams that each have a base end secured to the second
anchor and a distal end secured to the in-plane shuttle;
and
electrical couplings to direct electrical current through the thermal half beams via the
anchors to impart thermal expansion of the thermal half-beams and motion of their distal
ends.
2. (Original) The actuator of claim 1 in which the in-plane shuttle has a length and two
sides along its length and the first and second anchors are positioned to one side of the in-
plane shuttle.
3. (Cancelled)
4. (Original) The actuator of claim 2 in which the thermal half-beams have more mass
near their centers than at their ends.
5. (Original) The actuator of claim 4 in which the thermal half-beams are wider near
their centers than at their ends.
6. (Original) The actuator of claim 1 in which each thermal half-beam is secured
between its anchor and the in-plane shuttle at a non-orthogonal bias angle.

7. (Original) The actuator of claim 1 in which the in-plane shuttle is generally in-plane with the thermal half beams.
8. (Original) The actuator of claim 1 further including an alignment structure that is secured to the substrate and slidably engages the in-plane shuttle to constrain it to move generally parallel to the substrate.
9. (Original) The actuator of claim 1 in which the in-plane shuttle further includes one or more dimple bearings that project from the in-plane shuttle toward the substrate.
10. (Original) The actuator of claim 1 in which the thermal half-beams are formed of a material with a positive thermal coefficient of expansion.
11. (Original) The actuator of claim 1 in which the thermal half-beams have more mass near their centers than at their ends.
12. (Original) The actuator of claim 1 in which the thermal half-beams are tapered from their centers toward their ends.
13. (Original) The actuator of claim 1 in which the thermal half-beams have in-plane widths that are tapered from the centers of the thermal half-beams toward their ends.
14. (Original) The actuator of claim 13 in which the centers of the thermal halfbeams have widths that are about twice those of the ends of the thermal half-beams.
15. (Original) The actuator of claim 1 in which the in-plane shuttle has a length and two sides along its length and the first and second anchors are positioned on opposite sides of the in-plane shuttle and the thermal half-beams have more mass near their centers than at their ends.

16. (Original) The actuator of claim 15 in which the thermal half-beams are wider near their centers than at their ends.
17. (Original) The actuator of claim 16 in which the centers of the thermal halfbeams have widths that are about twice those of the ends of the thermal half-beams.
18. (Original) The actuator of claim 15 in which the thermal half-beams are tapered from their centers toward their ends.
19. (Previously presented) The actuator of claim 1 in which the floating cold beam is wider along a central region than at the cold beam ends.
20. (Original) A thermal microelectrical mechanical actuator, comprising:
a planar substrate with a pair of anchors secured thereto;
plural elongated thermal half-beams each have a base end secured to one of the anchors and a distal end secured to an in-plane shuttle having a length, the thermal half-beams having base ends secured to the pair of anchors being generally parallel to each other;
an elongate floating cold beam that is transverse to the length of the in-plane shuttle, the floating cold beam being coupled at one end to the in-plane shuttle and at another end to the substrate; and
electrical couplings to direct electrical current through the thermal half beams via the anchors to impart thermal expansion of the thermal half-beams and motion of their distal ends.
21. (Original) The actuator of claim 20 in which the in-plane shuttle has a length and two sides along its length and the first and second anchors are positioned to one side of the in-plane shuttle.
22. (Original) The actuator of claim 20 in which the thermal half-beams have more mass near their centers than at their ends.

23. (Original) The actuator of claim 20 in which the thermal half-beams are wider near their centers than at their ends.
24. (Original) The actuator of claim 23 in which the centers of the thermal half-beams have widths that are about twice those of the ends of the thermal half-beams.
25. (Cancelled)
25. (Cancelled)
26. (Original) The actuator of claim 20 in which each thermal half-beam is secured between its anchor and the in-plane shuttle at a non-orthogonal bias angle.
27. (Original) The actuator of claim 20 in which the in-plane shuttle is generally in-plane with the thermal half beams.
28. (Original) The actuator of claim 20 further including an alignment structure that is secured to the substrate and slidably engages the in-plane shuttle to constrain it to move generally parallel to the substrate.
29. (Original) The actuator of claim 20 in which the in-plane shuttle further includes one or more dimple bearings that project from the in-plane shuttle toward the substrate.
30. (Original) The actuator of claim 20 in which the thermal half-beams are formed of a material with a positive thermal coefficient of expansion.
31. (Original) The actuator of claim 20 in which the floating cold beam is wider along a central region than at the cold beam ends.
32. (Previously presented) A thermal microelectrical mechanical actuator, comprising:
a planar substrate with first and second anchors secured thereto;

an in-plane shuttle floating on the substrate for motion parallel to the planar substrate;
plural elongated thermal half-beams that each have a base end secured to the first anchor and a distal end secured to the in-plane shuttle, the thermal half-beams being tapered from their centers toward their ends;

plural elongated thermal half-beams that each have a base end secured to the second anchor and a distal end secured to the in-plane shuttle; and

electrical couplings to direct electrical current through the thermal half beams via the anchors to impart thermal expansion of the thermal half-beams and motion of their distal ends.

33. (Currently amended) The actuator of claim ~~34~~ 32 in which the centers of the thermal half-beams have widths that are about twice those of the ends of the thermal halfbeams.

34. (New) The actuator of claim 23 in which the floating cold beam is wider along a central region than at the cold beam ends.

35. (New) The actuator of claim 20 in which the thermal half-beams are tapered from their centers toward their ends.